THE TELEGRAPHIC JOURNAL.

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EXPERIMENT.

The chief function of a Journal like this is to supply an admitted want. All our student readers cannot attend lectures, join classes, or frequent libraries. We endeavour to meet this want by reporting lectures and supplying papers for study and thought. But we cannot make, though we can describe, experiments. No progress in any science can be made by the mere cursory reading of a lecture, and therefore our efforts to train electricians must fail unless the student repeat with care and exactness the experiments described. In our large cities lectures are so frequent, and physical literature is so abundant, that many satisfy themselves with seeing an experiment performed, or grasping its result from illustration and description, rather than by repeating it for themselves. It is not too much to say that an experiment is never properly comprehended until it is carefully performed, and it is the only effectual way to impress physical facts on the memory. An experiment is a knock at the door of Nature, and a successful experiment is an admittance into her secret stores. Experiment opens up the mind to, and lets in a flood of light on her mysterious ways. It is with regret that we see experiment going out of fashion. Where is the fine old glass cylindrical machine, and the equally useful Leyden jar?—instruments which have made nearly every living electrician. We scarcely ever see them in our shop-windows—we never see them in the student's hands; induction coils, magneto-electric machines, trembling bells, &c., are advertised and exhibited; but where are our old friends? A roughly home-made cylinder machine, warmed by the household fire, turned by little Bob, and applied to Pussy's nose, will teach one more of Electricity than all the paraphernalia turned out by our instrument makers. A glass tumbler filled with acidulated water, and supplied with a pair of plates, will instruct the mind more in a quiet evening than all the elaborate batteries of the trade. A little compass,—perhaps a mother's charm or a father's toy,—surrounded by a few coils of silk-covered wire, will exhibit more phenomena and supply more mental food than the most carefully finished galvanometer. The elementary facts of Electricity are so simple and so easily manifested that no one can be excused from availing himself of that great test of truth to satisfy his mind of their actuality. The simpler the means the more perfect and convincing the experiment. There are no class of persons so favourably situated for experiment as telegraph operators. Their business is a constantly repeated experiment. They have always currents at their disposal; wires, magnets, switches, batteries, surround them. There is no excuse for ignorance, or for the plea of want of means. Nevertheless, it is a most regrettable fact that experiment is rarely or ever resorted to, and those who should know most about the science in reality know least. There are some brilliant exceptions. In many of our large towns—notably Brighton, Leeds, and Bristol—mutual improvement classes have been formed by the telegraph staffs, and have proved very successful. They meet to read and discuss papers on various subjects. Do they experiment? Have they undertaken to repeat the illustrations in such lectures as Dr. Gladstone's? Do they make their own apparatus? Do they attempt original research? These are the means by which progress is made, knowledge gained, and science established.

JAPAN.

THE IMPERIAL COLLEGE OF ENGINEERING, TOKEI.

We have received the Calendar 1874-5 of this remarkable College, established in Japan. It has adopted as its motto "Energy." It has been established by the enlightened Government of that country for the education and training of young natives in Science and technical knowledge, with a view to their employment in engineering services. The regulations and syllabus of studies have been approved of by the Imperial Government of that country. The Principal is Prof. Dyer, of Glasgow, and he is surrounded by an excellent and able staff, amongst whom is Mr. Ayrton, of the University College, London, who passed a course of theoretical electricity under Sir William Thomson, in Glasgow; of practical telegraphy under Mr. Preece, in Southampton; and who was for some time in the Indian Telegraph Service. He is Honorary Secretary for Japan of the Society of Telegraph Engineers.

The Syllabus of the Course of Telegraph Engineering and the training the young Japanese will have to undergo appears to be very complete. It embraces the construction and working of Telegraphs and Torpedoes.

There appear to be nearly two hundred students, who are divided into cadets of the first year, cadets of the second year, and two preparatory classes, each divided into two sections. The course of training extends over six years, the last two years of which will be spent wholly in practical work. Workshops and drawing offices have been established, and a passage through them forms an essential part of the curriculum. Admission to the College is obtained by competitive examination, for which all Japanese subjects between the ages of 15 and 20 are eligible. The course classes and accessories are based upon the best European

models, and there can be no doubt that the young Japanese idea has the advantage over the generality of his European brethren in learning how to shoot.

THE THORPE RAILWAY ACCIDENT.

Sir Charles Adderley has addressed to the railway companies a circular letter, in which he announces the determination of the Board of Trade not to sanction the opening of single lines which may hereafter be constructed for public traffic, except upon the express condition either that they shall be worked upon a combination of the train staff with the block telegraph system, or that only one engine or train shall be allowed to be upon the line at any one time.

No one can doubt that freedom from accident is obtained not so much in that one system of single line working is superior to another, as that—whatever the system—it should be fenced about with checks and safeguards precisely expressed and carefully observed. In the accident in question there does not seem to have been any superfluity of these safeguards. Indeed the entire management and working of the fatal section would seem to have been dependent solely upon that human fallibility which, sooner or later, is known to fail. For years the working of the line had been conducted upon the same principle, and for years it had been conducted with perfect safety. However much this may have been due to light traffic, punctuality, or to other causes, perhaps none can tell; but this one fact stands boldly forth in the train of many another of its class, viz., that the human machine, without check, is not reliable.

At the same time, no one conversant with railway work would counsel reliance upon the block system alone as a form of protection any more than upon that source which has, in this case, given us such lamentable proof of its fallibility. The safety of the tremendous traffic which now fairly floods many portions of our important lines is to be secured only by ruling and regulating it under different organisations, all working independent of each other, yet harmoniously together. Thus, if a train break down in a block telegraph station, it is the first duty of the guard—although he knows that, if the block signal instructions are faithfully carried out, no other train will enter the section so long as his train is within it—to proceed some distance in the rear of his train, and there to protect it from any following train by such hand-signals as he has. On single lines the crossing points of trains are laid down in the time-tables, and so long as trains keep time the services of the Superintendent in charge of the line are not called into requisition, but on busy days—with extra trains and heavy traffic—his post is as onerous a one as may well be imagined. To him alone is entrusted the crossing of trains at other than the points laid down in the time-table. To many this may seem a mere matter of a message either way; as "A to B—Send on 3.5 train to C," and the reply "B to A—3.5 train left for C at —;" but the importance of the subject and the life at stake demand the greatest and gravest attention in forming the code of regulations by which these crossings are effected.

Probably no more perfect system exists than that in use upon the London and South-Western Railway. By its means for years the Company's single lines between Basingstoke and Exeter, the Portsmouth Direct, and the North Devon branches have been—and some portions still are, together with the Mid Hants line—successfully worked. The greater portion of these lines are now still further protected by block signals, but this in no way interferes with or alters the crossing places of trains. The Superintendent of the line, or section of line, alone is responsible for this, and crossings other than those laid down in the working time-table can only be effected under his orders.

The position of trains is notified by appointed "train signals" from certain stations: by this means the Superintendent is aware whether they are running to time, or, if not, how much they are behind, and regulates the crossings accordingly.

At each station four special pads of telegraph forms are kept solely for crossing purposes. Two of these pads are coloured *red*; the other two are coloured *green*. One of the red pads consists of forms headed "Order for Train NOT to proceed on Journey," and bears on the back of each red leaf a form headed "Special Order to Engineman and Guard NOT to proceed on Journey." The other red pad consists of similar forms, with the additional heading of "Agent's Reply," but with no form of "Special Order to Engineman and Guard" on the back. The one green pad consists of forms headed "Order for Train TO PROCEED on Journey," and bears on the back of each green leaf a form headed "Special Order to Engineman and Guard TO PROCEED on Journey.' The other green pad consists of similar forms, but each is headed "Agent's Reply," and bears no special order on the back.

Now suppose two trains, proceeding in opposite directions, are required to cross at Station B instead of Station A.

Station A is the regularly appointed crossing point, and the up train is to time, whilst the down train is considerably behind. In the ordinary course of things the up train will stop at A, whilst the down train would proceed on to the same point. The first thing to be done is to make sure of stopping the down train; B is accordingly telegraphed—

Keep 5.15 down train from W at B till 7.10 up train from X has arrived at B.

This message is then repeated back to insure correctness, and then handed to the station agent.

The agent then proceeds to put on the signals against the coming down train, and, having done so, he forwards the following reply:—

I will keep the 5.15 down train from W at B till 7.10 up train from X has arrived at B.

The Superintendent then proceeds to bring on the up train by telegraphing Station A:—

Send 7.10 up train from X on to B to pass 5.15 down train from W at B.

And during the time this is being repeated the station agent is writing the reply:—

I will send 7.10 up train from X on to B to pass down train 5.15 from X at B.

The order to stop and *keep* the down train at B has been written on the *red* pad with the form bearing

on the back "Special Order to Engineman and Guard NOT to proceed on Journey." Thus there are two forms, the one being a manifold copy of the other: of these, the upper form is for the agent, and is his authority for stopping and keeping the train; the lower is for the engine-driver and guard. This latter is then filled up and signed by the station agent, and on the arrival of the down train shown to the guard, and, on his having read it, given to the engineman, with instructions for both to attend to it.

The other red pad has been used for the agent's reply.

The order to send on the up train has in like manner been received on the green pad at A; and the reply having been sent, the agent proceeds to fill up and sign in ink the form headed "Special Order to Engineman and Guard TO PROCEED on Journey," and, having caused such order (with the telegram at the back) to be read by the guard of the train, gives it to the engineman. The train then proceeds to B, and, having crossed the down train, the agent then apprises the Superintendent of the same, which completes the proceeding.

Although this may seem a somewhat tedious and lengthy operation, it really occupies very little time in practice. With a properly organised system, well equipped, and well looked after, it is frequently completed in three minutes. Moreover, with proper foresight on the part of the Superintendent of the line, there is seldom need of hurry: the sections between stations on single lines are seldom so short as to occupy less than eight or ten minutes in travelling, and no superintendent would think of altering a crossing place for a less saving in time than this.

Now let us see how and what protection we get under this system at these crossing points, or in other words, to prevent two trains, proceeding in opposite directions, entering the same section.

First, then, we have the regular appointed crossing places by the time-tables, known to the agent, the signalman, the guard of the train itself, and the engineman,—all concerned in observing it.

Then we have, acting independently of this, the electric block signals, controlled and worked under separate and special instructions, which direct that—before any train is allowed to proceed into any section—the signals at the station in advance shall be placed at "danger," and only when this has been done and acknowledged shall the train be allowed to proceed.

Then, in case the crossing place is altered, we have, first, the train proceeding *to* the regular crossing station stopped, and only when such is known to be done is the other train moved forward. Not only is the agent made responsible in these transactions, but the signalman, the guards, and the engine-drivers,—the two latter having absolute, positive, and written instructions as to their movements. Not only is this so, but the very colour of the form on which the order is written is such as to denote its purport—*red* to stop, *green* to proceed.

Next to the "train staff" system, it seems scarcely possible to conceive a more perfect arrangement than this. The staff system has no doubt its drawbacks, and many ludicrous stories are told of it as to how trains have been kept waiting until the "staff" has been brought on by mounted messengers, and other means. So long as all goes well and regularly, it is an excellent protection; indeed under no circumstances, where worked upon the recognised principles, can an accident from two trains meeting occur.

But whether our single lines are in future worked upon the existing systems, by speaking telegraphs only, by speaking telegraphs combined with a regular system of block signals, or by the combined system of staff and block recommended by the Board of Trade, constant and critical supervision must be the rule. No matter what the system, however perfect, however plain and simple, however well understood, by strict control and by constant supervision alone will its efficiency be maintained. Where crossings are carried out by telegraph the detailed duties should be discharged by those only for whom they are appointed. Care should be taken to see that this is done. The telegraph forms should be regularly examined in order to see that they are so dealt with, and not one single point neglected.

The great protection to the travelling public, and to the railway director and shareholder no less than the public, will yet rest with the block system. Let lines be worked upon the staff system or by the message system, errors will arise and accidents follow. It is the old story of all the eggs in one basket. One little error without check, and the deed is past recall. With the block system we have that check; for although not impossible, it is scarcely probable, that two systems working so independent of one another should agree to commit so serious and consentaneous a blunder. We cannot but believe railway managers are every year becoming more and more alive to the advantages of the block system; and now that railway companies are the maintainers of their own telegraphs we look forward, at no distant date, to see the whole of our railway systems provided with this most necessary adjunct.

THE VOLTAIC BATTERY.

A COURSE OF SIX LECTURES,

By DR. JOHN HALL GLADSTONE, F.R.S.,

Fullerian Professor of Chemistry, Royal Institution.

DELIVERED AT THE ROYAL INSTITUTION OF GREAT BRITAIN.—CHRISTMAS, 1874-5.

LECTURE II.—THE REPLACEMENT OF METALS.

IN my previous lecture I spoke of metals, of acids, and of salts. Now, as I want above everything to be clear, I should just like to spend a minute or two in explaining the meaning of those terms. I shall use them over and over again to-day, so they ought to be clearly defined.

As to metals, I do not think any boy or girl in this room will have much difficulty in understanding what they are, although perhaps you could not define them as a chemist would. We all know the metals copper and zinc, silver and gold, iron and tin, and many others.

As to acids, there are a great number of acids known to chemists. They are called by that name because they generally have a sour taste, but that is not a necessary property of them. They all consist of two parts, and one of those parts in a proper acid is hydrogen; they are formed, in fact of hydrogen and something else.

A salt also consists of two parts. You are acquainted with common salt, and with some others, such as smelling salts and Epsom salts; but we chemists know a great number. There are several upon the table. Here is one, sulphate of copper: here is another, nitrate of silver. These are all substances that resemble one another in this respect—that they consist of two parts, and one part is a metal. The other part I do not exactly know what to call it before you to-day. I might name it an acid, but that would not be very accurate. I might call it an electro-negative element—that would suit my present course of lectures, no doubt; but as yet it would not be intelligible. Well, then, we must remember that every salt consists of two parts—a metal and something else; and we must remember, also, that every acid consists of hydrogen and some other thing. For instance, sulphate of zinc consists of the metal zinc along with the sulphuric element. Sulphuric acid consists of hydrogen and this sulphuric element: the hydrogen plays the part of a metal. I hardly like to say that hydrogen is a metal; for though chemists could give twenty good reasons why hydrogen should be considered such, and none why it should not be, still it is so unlike a metal that you would hardly forgive me if I called that light gas, which floated our balloon to the upper regions of this room, a metal. You will please to remember, then, that when we speak of salts, or salts dissolved in water, we are speaking always of something which can be divided into a metal and some other substance.

In the last lecture we had a large cell in front of us, as you will recollect; and in that cell you saw zinc dissolving in sulphuric acid. You will recollect that the zinc turned out the hydrogen from the sulphuric acid. You recollect, too, that the copper could not turn out the hydrogen from the acid. But we can make copper join with sulphuric acid in another way, so as to form this blue salt, which is often called blue vitriol. It exists in the form of beautiful crystals, which you can come and look at after the lecture if you like. Here are some fine, large, noble crystals of this blue salt—sulphate of copper. Now if I were to take some of this sulphate of copper, and dissolve it in water, and put a piece of zinc into it, we should find that the zinc would turn out the copper, just as the zinc turned out the hydrogen. I will dip the zinc into the solution, and then we will have a light turned upon it, and so I shall be able to show it more clearly to you. When I dip the zinc into the solution I see that there is a commotion taking place, and I have little doubt that upon taking the zinc out of the sulphate of copper we shall all see that something has happened—that, in fact, copper has been deposited upon the zinc. You know that copper looks, generally, a red metal; but I will not promise you beforehand that this will appear very red, for its colour will depend upon circumstances. Here is the metal copper which has been deposited upon the surface of the zinc. You can see it by means of the electric beam. Here is some sulphate of zinc taken from some of our batteries. We will take a little of this dissolved salt, and put the copper into it, and let it stand. Now, shall we find that the copper is capable of turning out the zinc? No. We may keep it in the solution as long as we please, and we shall find no effect whatever. There is no white zinc deposited on that red copper. If we hold it in the light we shall see that the copper looks just the same as before I put it in. There is no metal deposited, and no change.

We find, then, that the zinc can turn out the copper from sulphate of copper, but the copper cannot turn out the zinc from sulphate of zinc.

Let us go a little farther. Suppose we take some other metal. I will begin with a silver salt. These two vessels originally had some nitrate of silver in them—a salt that is sometimes called lunar caustic. Some mercury was put into these vessels. This one was prepared by Prof. Faraday,—of course several years ago,—and it is kept as a memento of him. This other specimen was prepared within the last few days, and we will make use of it because it stands up better. The mercury has turned out the silver, so that the silver is growing like crystals. Let us see how it looks in the electric light. [The vessel containing the silver crystals was placed in the track of the electric beam.] We have thus found that mercury will turn out silver, or that mercury is stronger than silver. We will, therefore, write "silver" on the black board, and put "mercury" underneath it. Mercury has a greater—what shall I say?—a greater attachment for the acid that is in the salt than silver has? We may, perhaps, say that the acid prefers the mercury to the silver. It is just as it might happen with any of you. Suppose you have two friends, but you prefer one friend to the other; then if you are with the one whom you do not like so much, and the other comes near you, you cease talking with the first, and begin talking with the second, whom you like better. So it is with the silver and the mercury. The nitric element prefers the mercury to the silver. Now is there anything that is pleasanter than the mercury? Let us see. I have here a solution of mercury. It is the chloride, and in this case I will take a strip of copper and place it in the solution. You see it comes out quite dark, I will leave it a little longer, that it may become a litttle darker. You will understand already that this copper is turning out the mercury. The mercury is being deposited on the copper, and the copper, of course, is dissolving, at the same time, in the acid. Here is the copper, you see, with the mercury upon it. Probably if I were to rub it you would see the mercury better. You know that mercury is the same as quicksilver, and that which has been deposited has a silvery appearance now I have rubbed it, although it was only grey before.

So far, then, as we have advanced, we find that the copper is more powerful than the mercury. We will write the word "copper" under it in our list. Now let us go a little farther, and see whether there is anything stronger than copper. I have got a solution of sulphate of copper, just as I had before; but I will not take, as I did in the former case, a piece of zinc, but a piece of tin. You can hardly see what is going on, because of the deep colour of the solution. But let us see whether we get any red copper upon the tin. You must understand that we do not always get metals of the colour that you would expect, for the colour depends very much upon the condition in which they are produced; thus, probably, by the aid of the microscopes which have been placed in the adjoining room, you will see that gold may be black,

or green, or lilac, as well as yellow. Now, then, we will examine the tin. I think you will see, at any rate, that there is some copper deposited upon it. I will leave it a little longer in the solution, and then we shall see the result better, and we shall probably get the true colour of copper. However, you can already see that a change has been produced, and so I will write down "tin" under copper. Now here is a solution of tin—tin in the form of chloride. You cannot see anything; the solution looks like common water. But I will place in that salt of tin a sheet of zinc, and we will see what the result will be in that case. I do not think that the action will take very long,—only you know that tin looks very much like zinc; that is the worst of it, and therefore we shall be unable to see the appearance of the tin upon the zinc very plainly, although the action will be rapid enough. Let us see. There is no doubt about a great deposit having formed upon the zinc. Here is the tin deposited, and therefore I will next write down "zinc."

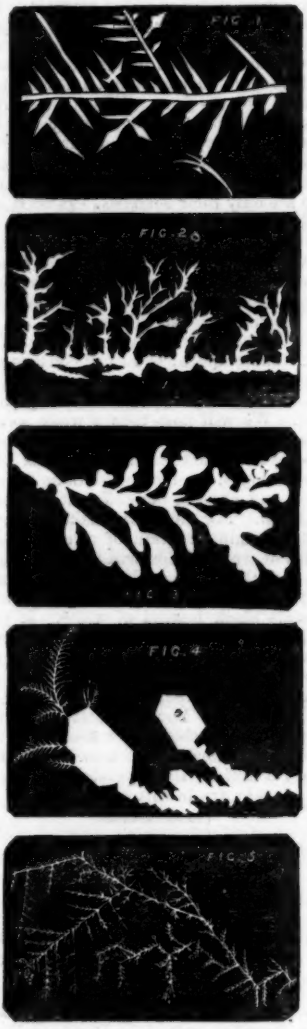

Fig. 1. Silver crystallised from weak solution.
" 2. " " " strong solution.
" 3. " " " very strong solution.
" 4. " "
" 5. " " " nearly exhausted solution.

Now we will go farther, and see whether anything will turn out the zinc. Here I have a solution of sulphate of zinc,—that same salt which we have been dealing with recently,—and I will take the metal magnesium. It is a metal which is very easily destroyed and rusted. I will put it into the solution, and we shall find that it will begin to act in more ways than one, and make a good deal of commotion in the liquid. You observe that there are bubbles forming, and altogether you see great signs of chemical change. If we bring the magnesium out again we shall find that it has thrown down the zinc upon it, but the zinc will not be white. It is thrown down very finely divided, so that it will appear black, or nearly so. There is this grey appearance of the zinc upon magnesium,

Silver crystallised from 2½ per cent solution magnified four times.

I think, then, that I may write down "magnesium" after zinc. I might have gone farther if I had chosen, because we might take magnesium and treat it with potassium; but I cannot show you that in water very well, for potassium would catch fire under such circumstances; but the method of producing this metal, magnesium, is by decomposing its salts by means of potassium or sodium. We will therefore put down "potassium" at the end of our list

Silver.
Mercury.
Copper.
Tin.
Zinc.
Magnesium.
Potassium.

I mean to keep this list on the black board for another lecture, in order that I may show you something more of its significance. At the present time it stands before you simply as a list of metals, each of which is stronger than the one preceding it. The weakest is at the top, the strongest is at the bottom. When I say "the weakest," I mean that the lower ones will always turn out those above them. It depends a little upon the acid that is connected with them, but at present we will not say more upon that subject. The force which operates in these cases is what is called "chemical force" or "chemical affinity." It has been known from the early days of chemistry that there was this disposition of an acid to combine with one metal in preference to another.

You can all make these experiments very easily at home. I will vary them with an experiment with a different metal. Iron will turn out copper. You can take a solution of copper, and dip your knife into it, and then you will find that the iron knife apparently turns into a copper knife, in consequence of copper being deposited on its surface. I have dipped this knife into a solution of a copper salt, and we will see whether the copper has covered the blade already. Yes, it has done so; there is not any doubt about the copper having altered the appearance of the knife, and made it look like a copper knife rather than a steel one.

When one metal is displaced by another, it usually comes down in a crystalline form. Some of those crystals you have been looking at in the microscopes outside. I will show you how to make them. If any girl or boy rejoices in a microscope, or any kind of magnifying glass, there is hardly anything that they can have for examination more beautiful than what can be produced by means of a little nitrate of silver and a bit of copper or brass. I will just place a drop of the silver salt in contact with a piece of copper, and I have purposely put it upon a piece of blue glass, because I think the crystals look prettier upon blue glass than upon white. You can buy this nitrate of silver yourselves, either in crystals or in sticks, and you may dissolve it either in distilled or in rain water; then you can take a little piece of copper or brass,—it does not matter which,—and pour some of the solution upon it. As soon as we put the copper into the liquid we shall see at once that something begins to form upon it. What happens is the growing of a sort of hoary beard all about the red metal. The crystals are now growing, and if I take a magnifying glass, such as some of our elders use to read with, and look at the copper in that way, I see a beautiful crystalline fringe of white metal growing around it. I will allow it to grow, and we can examine it afterwards. I will put the glass beside it, so that you may see it better; but as you cannot see that until you come down to the table after the lecture, I should like to show you upon the screen some of these crystals. We will take a solution of silver, and some copper, and show you the way in which the silver crystals grow. Of course these preparations sometimes take a little time in arranging, and we must give the crystals time to form. What we shall throw upon the screen may appear rather pretty to you; but, to my eyes, the crystals appear so very much better when we look at them with a common microscope, that they scarcely appear pretty to me when we see only their shadows. It need not be a powerful microscope to show you this effect. Any ordinary microscope will answer. [The shadow of a piece of copper upon which silver crystals were being formed was focussed upon the screen.] That black thing is the copper, and you see these crystals of silver growing upon it. I can see by the appearance that this is rather a strong solution of nitrate of silver. There appear to be little bushes growing out from the copper; you can see them growing. But we must not dwell long over any particular specimen. We will now take a weak solution of nitrate of silver. It is a very good thing, by the way, when you make experiments of this kind with your microscopes, to make solutions of different strengths, and observe the different effects which are produced. For instance, make a very weak solution containing 1 grain of nitrate of silver in 100 grains of water. You will then get the copper covered with little black bushes. It seems very strange that the difference of strength should make the crystals black instead of white. If you have the solution a little stronger you will find little fern leaves growing out, and if you have a still stronger solution—a 5 per cent or 10 per cent solution—you may have little juniper bushes growing out in various directions. You see that when we have this weak solution there is a somewhat different form from what there was before. In the case of the strong solution, the crystals were more like a fringe than they are in this case.

(To be continued.)

Notes.

The following letter, with reference to the Direct United States Cable Company, has appeared in most of the daily papers:—

Sir,—I am desired by my Board to inform you that the *Faraday* arrived in Portland Roads this morning, at 3 A.M. She will proceed to Gravesend for the purpose of refitting and taking in stores. So soon as this object is accomplished, she will at once resume operations. The Direct United States Cable is now laid from Ireland to the United States, with the exception of 260 miles. This interval is not in deep water, and the delay in completing has been caused by a succession of severe gales. The position of the end of the cable is exactly known, and the officers in charge of the Expedition state

that there will be no difficulty in completing the laying when the weather moderates.

I am, Sir, your obedient servant,

CHARLES S. CLARKE, Secretary.

Palmerston Buildings, Old Broad Street,
London, E.C., Jan. 18.

Severe gales were not the only difficulty with which the *Faraday* had to contend. Fogs—of a density unequalled by any English mist, or, to quote the words of one who was on board, "as thick as cotton-wool"—would, in an incredibly short space of time, settle in around the ship, and entirely paralyse operations. For three weeks, almost at the outset, she was enveloped in one of these: this it was which led to the propagation of the rumour as to the loss of the vessel—a rumour which emanated, we believe, from an *employé* in the joint office of the Anglo-American Co. and Western Union Co., at Placentia. Judging from all accounts the *Faraday* would appear to have behaved splendidly during the trying time that she has had to pass through, and to have falsified in no way the high expectations which were raised respecting her after she left the builder's hands. She has now gone to Newcastle to have some damages, sustained in the recent storms, made good, and she then proceeds to New York.

The new enemy to our submarine cables which has appeared on our sea coasts, and which has developed a strange taste for gutta-percha, has been found to be the *Limnoria terebrans*, a little insect about one-quarter of an inch long. The *Limnoria terebrans* is not the only enemy to gutta-percha covered wires. Rats, in several instances, have developed a strong taste for this insulating medium. In Bristol, lately, they succeeded in finding their way—owing to the subsidence of the soil—out of an old drain into the flush boxes in the streets, and devouring the gutta-percha coating of the wires, which were thus exposed. Some even ascended the pipes, helping themselves to a mouthful of gutta-percha at different points. It is probable, however, that the shocks which passed through them, on reaching the copper wire, so astonished their weak nerves that the damage they committed was not serious.

From a correspondent in New Hampshire, U.S., we have received the following account of the construction of an overground line lately erected there, which cannot fail to interest our readers:—

"The materials used are—the American patent compound wire and Brooks's insulator. The poles are some of the best that I have seen, but I cannot definitely say what class of timber is employed, as I am not yet *au fait* in the different kinds of wood which are grown here. Specimens of the compound wire I have seen in England: it is mainly composed of steel or homogeneous iron, with an envelope or coating of copper, and over this an external covering of tin. It is supposed to possess a higher conducting power than the ordinary line wires, and consequently need not be so large or heavy as they are. After the erection of the poles, with the insulators fixed to them in the ordinary way, the process of running and stretching the wire is commenced. The wire, which is prepared in coils of a mile in length, is placed on a drum (one coil at a time); this is fixed to a small wagon, and, after shackling off, away they start, uncoiling the wire as they go. The entire wiring gang consists of but five or six men,—one to attend to the wagon; two to bind in the wire to the insulators, *i.e.*, one at a pole; and two or three for stretching the wire, which is done by hand. The horse moves off; the two men, having strapped the climbing-irons on to their legs, ascend the poles, and hook the wire on to the insulator. Speaking of these climbing-irons, they seem to me to be wonderfully good things for telegraph work, and I am surprised that no attempt has ever been made to introduce them into England. They have a spike on the inner side of the instep of each foot, and by means of them a pole is scaled as easily as if a ladder were employed, whilst they dispense with all the trouble and expense of carrying it about. The wire, being hooked into the insulator, is then pulled very tight by the two or three men whose special duty this portion of the work is, and finally bound in—by the men up the poles—with pieces of the ordinary binding wire some 4 inches in length. Each of these operations occupies almost less time than it takes me to describe them; and, although it appears next to incredible, I have seen the gang of whom I speak run, stretch, and fasten off as much as 16 miles of wire in a day,—not in one solitary instance, but on several occasions. I have never seen a wire stretched tighter with the vice; in fact, I think they err out here in pulling their wires too tight; it would never do to pull the ordinary line wires like this: however, if they weather the frost, a few ohms in the resistance will doubtless be saved! The lines are worked in closed circuit."

Climbing-irons are, however, in use in England but to a limited extent. Linemen do not like them. The compound wire alluded to in the above letter has proved itself, in New York, greatly inferior in strength to ordinary galvanised iron wire. The Police and Fire Alarm lines of that city were constructed with that wire, and the snow-storm of December 20th entirely demolished them. The wire when laid on the ground showed no trace of the copper—nothing but steel remaining, and that nearly eaten through by rust. Great efforts were made to introduce the compound wire into England, but after a few trials Mr. Culley—anticipating exactly what has happened—declined to employ it for the Postal Telegraph lines.

Mr. Bridgeman, of Norwich, some two years ago, showed that by passing a current through a plant case in which cress seed was sown, the growth around the negative pole was considerably healthier and more luxuriant than that around the positive pole.

M. Onimus, of Paris, has tried the same experiment on frogs' spawn, and states that the development of the eggs which are in connection with the negative pole is considerably accelerated over those which are in connection with the positive pole.

It is announced that the proposed Telegraph Conference at St. Petersburg will probably meet in the month of May or June. The Russian Telegraph Department will supply the President and undertake the business management. The Submarine Companies will be well represented. The principal proposal designated for discussion is the suggestion that in future the tariff should be framed not as at present, according to the number of words, but of single letters, contained in a message, as Continental Companies find the scope given to the use of compound words largely abused.

One of the most striking feats in the history of Telegraphy was realised in connection with the report of Mr. Bright's speech at Birmingham, on Monday evening last. The proceedings at the meeting in Bingley Hall commenced at 7 P.M., and continued until considerably after 10 P.M. Reporters stationed in the Hall handed successive slips of notes to the messengers of the Post-Office Telegraph Department waiting in attendance, and by them they were rapidly conveyed in cabs to the Telegraph Office. The Wheatstone automatic instrument was called on for the exertion of its utmost powers, and no less than sixteen transmitters were in operation at the same time, assisted by a number of ordinary Morse printers worked by a key. By the use of these agencies verbatim reports of the speech of the great tribune, with summaries of the observations of less weighty speakers, were simultaneously despatched to almost every town of importance in the kingdom, Birmingham being in direct communication with every great centre of population lying between Aberdeen and Plymouth, and between Belfast and London. In all 258,000 separate words, equal to 130 newspaper columns, were signalled; and as some despatches were furnished to two or more addresses in the same town, the number of words actually delivered and published equalled 580,000, or nearly 300 columns. The energy of the proprietors of one London newspaper, *The Hour*, gave special illustration to the powers possessed by the existing telegraphic organisation. Proceedings terminating at 10 P.M. in Birmingham were fully reported to the office of the journal in question, in Fleet Street, London, at 11.30 P.M., and were published—to the length of about five columns—in a special edition of the paper that prior to midnight was being lustily cried through the metropolitan thoroughfares. In Birmingham itself the local press was not enabled to issue their report of the Bingley Hall Meeting until close on 11 P.M. The proprietors of *The Hour* were so impressed by the value of the service rendered to them that they accompanied their report of the proceedings by a graceful compliment to the efficient organisation and successful energy of the Postal Telegraph Department.

The cable connecting the Orkney and Shetland Islands is broken down. Messages are dependent on sailing vessels.

Proceedings of Societies.

SOCIETY OF TELEGRAPH ENGINEERS.

INAUGURAL ADDRESS, BY MR. LATIMER CLARK, PRESIDENT. JANUARY 13, 1875.

GENTLEMEN,—On assuming the Chair as President of the Society of Telegraph Engineers, I desire to return you my thanks for the confidence you have shown and the honour you have done me in placing me in so responsible a position. Although I shall willingly devote and unite my best efforts with yours to uphold the interests and dignity of the Society, and to increase its utility, and although I shall fulfil these duties as a labour of love, I am conscious that I shall have to ask your continued forbearance and indulgence for deficiencies.

My task is, however, but a light one compared with that which devolved on my predecessors in this chair. They had to create and establish the Society, and to perfect its organisation; and, thanks to their wise and skilful guidance, and to the liberal assistance of the Institution of Civil Engineers, we are able to meet in this magnificent room this evening some 600 members strong, and to chronicle nothing but prosperity and progress.

In this respect, indeed, we have ground for sincere congratulation, for even the parent Society—the Institution of Civil Engineers, one of the most prosperous and flourishing institutions in the world—was, I believe, thirty years in existence before it possessed as many members as we now number in our single branch of the profession.

The Electric Telegraph is not the creation of any one mind, nor did it come upon the world suddenly or in a complete form; but, like the pale beams of the rising moon, its dawn may be traced back for generations, continually brightening and gaining strength as fresh additions to our knowledge rendered the problem more feasible.

Practical telegraphy is, however, a creation of the present generation. Within the memory of most of those now present it has burst into existence and spread throughout the world with a celerity and splendour characteristic of the mysterious element which it has bent to its service, so that to-day—from the distant shores of the Pacific Ocean to the eastern limits of Asia—not only every land, but almost every town and village, has been united by the electric wire, and distance and time have been so changed to our imaginations that the globe has been practically reduced in magnitude, and there can be no doubt that our conception of its dimensions is entirely different to that held by our forefathers.

It is impossible to avoid looking back and inquiring what has been the cause of this singular development; and, although the ground has been trodden so often, I cannot refrain from passing in hasty review some of the steps in the rise and progress of telegraphy. For, though the history of our art may receive but little

attention from the world at large, it must ever possess an interest for the members of this Society, many of whom have borne so prominent a share in its creation and development.

There was a fabulous story among the old authors that two needles touched by the same magnet, and suspended within an alphabetic circle, would move in unison at whatever distance they might be separated. The most interesting form of this story is that related by Joseph Glanvill, M.A., in his "Scepsis Scientifica," published in 1665. He says—"That men should confer at very distant removes by an extemporary intercourse is another reputed impossibility; but yet there are some hints in natural operations that give us probability that it is feasible, and may be compassed without unwarrantable correspondence with the people of the air. That a couple of needles equally touched by the same magnet being set in two dyals exactly proportioned to each other and circumscribed by the letters of the alphabet may affect this magnate hath considerable authorities to vouch for it. . . . Now, though this pretty contrivance may not yet answer the expectation of inquisitive experiment, yet it is no despicable item that by some other such way of magnetic efficiency it may hereafter with success be attempted when magical history shall be enlarged by riper inspections, and it is not unlikely but that present discoveries might be improved to the performance."

Now here we have the early dawn of the idea of an electric telegraph.

On the 1st of February, 1758, a Scotchman, Charles Marshall, of Paisley, then resident at Renfrew, published, in the *Scots Magazine*, a full and clear description of a practicable electric telegraph, and suggested the coating of his wires with an insulating material; and he may be therefore considered, in a sense, the inventor of the telegraph.

In 1800 Galvani and Volta introduced the voltaic pile, which forms so important a feature of the telegraph of to-day.

From this time many other forms of telegraph were proposed which it is unnecessary to notice, except that in 1809 Dr. Sœmmering laid before the Academy of Science at Munich a plan in which, for the first time, the galvanic battery was employed for the transmission of the current and the decomposition of water. He also expressed the hope that his system might serve to telegraph between Munich and Augsburg, and took much pains to make it known.

In 1816 our late lamented member, Sir Francis Ronalds, produced his electric telegraph, and at great expense and trouble erected a considerable length in his garden at Hammersmith. He employed frictional electricity and only one wire, and exhibited his signals by the divergence of pith balls, combined with rotating dials working synchronously,—a system afterwards brought to great perfection in the printing telegraph of Prof. Hughes. Sir Francis Ronalds will always take a high position in the history of the telegraph,—not so much on account of the excellence or originality of his invention, as on account of the confidence and ardour with which he pursued his experiments and endeavoured to bring them to the notice of his countrymen. With wonderful prevision he fully perceived its value and foretold its destiny. His "Description of an Electrical Telegraph," which was published in 1823,—the first book ever published on the subject of Electric Telegraphy,—might almost serve for a description of a telegraphic system at the present day. He proposed the establishment of telegraph offices throughout the kingdom, and pointed out the benefits which the Government would derive from their existence. He described methods of insulating the wires either on poles or underground, with all the details of tubes, joints, and testing boxes, testing stations, linemen, and inspectors, as at the present day. But the most interesting and singular point to my mind is the clearness with which he foresaw and explained the phenomenon of retardation of the electric current by induction in underground wires,—a phenomenon which has so greatly engaged the attention of electricians in the present day.

The influence of this is so great that on our Atlantic cables we do not transmit messages at a greater rate than fifteen or twenty words per minute, whereas, if the effects of induction could be removed, we might transmit three or four hundred words per minute. After showing that the discharges through his 8 miles of insulated wire were apparently instantaneous, he says—"Yet I do not contend, nor even admit, that an *instantaneous discharge* through a wire of unlimited extent would occur in all cases." And recurring to the subject further on he says—"That objection which has seemed to most of those with whom I have conversed on the subject the least obvious appears to me the most important, and therefore I begin with it, viz., the probability that the electrical induction which would take place in a wire enclosed in glass tubes of many miles in length (the wire acting like the interior coating of a battery) might amount to the retention of a charge, or at least might destroy the suddenness of the discharge, or, in other words, might arrive at such a degree as to retain the charge, with more or less force, even when the wire is brought into contact with the earth." He then proceeds to suggest methods of obviating the difficulty, or experimentally demonstrating its extent and character.

There can be no doubt that if Ronalds had worked in the days of railways and joint stock enterprise, his energy and skill would have triumphed over every difficulty, and he would have stood forth as the practical introducer of the telegraph. But he was thirty years before his age, and the world was not ready for him.

Having completed his arrangements, he modestly invited Lord Melville—on the 11th July, 1816—to witness his experiments, in order that he might demonstrate the nature and merits of his invention. The reply he eventually received was eminently characteristic of the neglect, and even contempt, with which science and scientific men were, and to some extent still are, regarded by statesmen.

"Mr. Barrow presents his compliments to Mr. Ronalds, and acquaints him, with reference to his note of the 3rd instant, that telegraphs of any kind are now wholly unnecessary, and that no other than the one now in use will be adopted.

"Colonial Office, 5 Aug., 1816."

The inventor had chosen an unfortunate time. The great war of the century was concluded; the Government officials were doubtless closing up their affairs after a weary Session, and were thinking only of salmon and grouse; telegraphs and all other new-fangled ideas were wholly unnecessary; and Mr. Ronalds was probably only one amongst a dozen of inventors who received their *coup de grace* on that unlucky August morning.

Ronalds was, however, contending against one difficulty which, as we now know, would have been almost insuperable. Although very familiar with the galvanic pile, and although Sœmmering had used it for telegraphs seven years previously, he was still working with high tension or frictional electricity.

(To be continued.)

PHYSICAL SOCIETY.

Saturday, November 21st, 1874.

Dr. J. H. Gladstone, F.R.S., President, in the chair.

At this meeting, held at the Science Schools, South Kensington, eight new members were elected.

Prof. MACLEOD made a communication "*On a Simple Apparatus for Showing Internal Resistance in Battery Cells.*" Two tubes about half a metre long, and one of which is twice the diameter of the other, are closed at their lower ends with corks. On the corks, and within the tubes, rest two discs of platinum foil, connected with binding-screws by platinum wires passing through the corks. The platinum plates are covered with small quantities of chloride of silver, and the tubes are filled with a solution of chloride of zinc. Each tube is provided with a disc of amalgamated zinc soldered to a long copper wire, which is well covered by an insulating material. The discs are cut so that they nearly fit the tubes, one being exactly double the diameter of the other, and therefore exposing four times the surface to the action of the liquid. On connecting the terminals with a galvanometer, the current will be found to increase as the distance between the zinc and platinum plates is diminished by lowering the zinc plate in the tube. In order to obtain the same deflection of the galvanometer by the narrow cell, the distance between the plates must be one-fourth of the distance between those of the larger one.

The apparatus may also be used to show that opposed cells of the same kind will not produce a current. For this purpose the platinum plates are connected together, and the two zinc plates joined to the galvanometer. No current will flow, whatever the distances between the plates.

THE TELEGRAPH ELECTRICAL SOCIETY, MELBOURNE.

THE first Ordinary General Meeting of this Society was held on Wednesday, 12th August, at 8 P.M., at the Melbourne Athenæum, Mr. D. J. MCGAURAN in the chair.

The minutes of the previous meeting having been confirmed, the Chairman called upon Mr. L. S. Daniel to read a paper he had undertaken to produce on "*The Object, the Use, and the Working of the Telegraph Electrical Society.*"

Mr. DANIEL then read as follows:—

It is with considerable diffidence that I have undertaken to be the first to address this newly-formed Society; but as, from the first, I had determined upon doing my best to assist it by every means in my power, I felt that I could not well decline coming forward, at the request of the Committee, on the present occasion.

The subject on which I propose to try and gain your attention is that of the Society itself. I think that we should thoroughly understand why we are met here to-night, and why we have formed this Society. To put the matter in its simplest form, I would say that we are met here to gain power. Knowledge is power, and our object is to increase our knowledge. The acquisition of power will increase our value, will cause attention to be drawn towards us, and will improve our position. I need scarcely say that, if our value be increased, and our position improved, we may naturally expect a tangible recognition of this improvement; but I confess that I would never have thought of putting the matter in such plain language as I find it in the *Journal of the Telegraph Engineers' Society* of London. While I was searching for material from which to form the present paper, I came across the following passage in a lecture on the advantages of scientific education, published in that journal, and addressed to the Telegraph Staff of London, by Mr. W. H. Preece, C.E., and Member of the Society of Telegraph Engineers. [Here follows a long extract.]

He adds that *pecuniary advantages must necessarily accrue* to such as avail themselves of the opportunities of acquiring this knowledge; and to put his meaning out of all doubt, he heads this division of the advantages of scientific education with the magic word *Pay!*

With such an authority as this before us, I do not think that we need now hesitate to declare openly that one of the results we hope to obtain from the successful establishment of this Society is increased pay. I almost think that this result alone would be sufficient, in many instances, to induce a large number to enrol themselves members; but Mr. Preece points out, also, that there is pleasure as well as profit in acquiring scientific education, and I may say that I anticipate that many of us may eventually experience great pleasure in the fact that our scientific studies, prosecuted in connection with this Society, will have improved our social position and standing in society. I think, then, that in saying that this Society is established for the pleasure and for the profit of its members I shall not be far wrong, and that two better reasons for establishing any Society could hardly be found.

Most of us have been intimately connected with Telegraphy for many years,—for so long, in fact, that it would be a hard matter for us to adapt ourselves to any other calling; and I think that very few of us have any idea of following, or would wish to follow, any other calling. But, while years have been passing on and changes have been made, most of us must admit that—so far as scientific knowledge of our occupation goes—we have been standing still, or almost standing still. I believe that the time will shortly come when—if we do not arouse ourselves from this lethargic state—we shall find ourselves quietly passed by, by a new generation, who will wonder at the ignorance displayed by men who, as they will say, have been all their lives concerned with Telegraphy, and yet know so little about it. This is not a pleasant state of things to contemplate, and I confess that this idea has haunted me for a considerable time, and I hail the present movement as a favourable opportunity for us to commence a new state of things, and to lift ourselves at least up to the level of our fellow-telegraphists in other countries. We are, from our geographical position, much isolated from the great telegraphic centres, but this should be no obstacle to our being at least their equals in practical and scientific knowledge, and I may say—with, I hope, a pardonable pride—that I have such faith in Victorian energy and intelligence that I do not despair of seeing this Society, by its members, become favourably known and honourably ranked among the older and and more pretentious European and American societies. But certainly I have no wish to begin "blowing" already as to what we will do. At present we have only to confess that plenty of room exists for our self-improvement.

I have said that this paper which I am now reading would be "On the Object, the Use, and the Working of this Society." To a great extent the two first terms are identical, but on closer inspection it may be seen that an inquirer might ask us "What is your object in forming this Society?" and when told what our object is, he might say, "And what is the use of it?" and then "How do you propose to work it?" I will therefore endeavour to answer our imaginary querist in the order of his questioning. What, then, is our object in bringing this Society into existence? It is, as we have already declared in general terms at our preliminary meetings, "for the promotion of the knowledge of Electricity, more especially as connected with Telegraphy." That is no doubt a good abstract answer; but I will now endeavour to give some details as to what I consider should be the object of the Society. It should help us to acquire a thorough knowledge, theoretical and practical, of the means used by the most advanced telegraphists to carry on their work, and we should endeavour to so perfect

ourselves in this knowledge that it should be just as easy for us to thoroughly understand the use and theory of, say, Wheatstone's bridge (I select this because I confess that I really know nothing whatever about it) as of a simple Morse instrument. I have no doubt that to most of us, years ago, the mastering of the theory of the Morse instrument was considered a very satisfactory intellectual feat, and I remember when I thought I had some claim to consider myself well advanced in electrical knowledge when I had thoroughly mastered the deep mysteries of a repeating switch! I need not say how many years ago this occurred, but I bring it forward as an illustration of what I think will be the case if we apply ourselves honestly to the study of other problems connected with Electric Telegraphy, which, I am sure, cannot appear more mysterious to any of us now than the repeating switch did to me years ago. In acquiring this knowledge we must be careful not to look too far ahead at first. Many a tourist has turned back from the ascent of a high mountain from losing heart at the apparently inaccessible heights as seen from the foot, where a more sensible traveller, plodding carefully on, arrives at the summit without perhaps having actually encountered any obstacles. I believe that if we do not lose heart at first, but plod carefully along, examining *more* the ground that we are *going over* than the difficulties before us, we will ultimately arrive at a very respectable height of knowledge of Electrical Science. The knowledge of Electricity as confined to Telegraphy is not, however, the sole object of this Society. Electricity in any form is so intimately connected with the present system of Telegraphy that it will be one of the ends of the Society to encourage, as far as its limited means will allow, the prosecution of researches into that inexhaustible mine of Science.

A third object of this Society will be to endeavour, as much as possible, to keep its members posted up in *electrical news*, by means of journals or other periodicals issued by kindred Societies in Europe or America. Of course, the extent to which this can be done must depend on the funds available for doing it.

If, then, I say that the direct objects of this Society are—1st, The acquiring of knowledge of the higher branches of Electric Telegraphy; 2nd, The acquiring of knowledge of Electrical Science in the abstract; and 3rd, The keeping its Members informed of the movements and changes that are taking place in the great centres of Telegraphy; and that, by acquiring this knowledge, they indirectly gain *power*, and very probably *pay*, I think that will be sufficient answer to the question of "What is the object of this Society?"

(To be continued).

Notices of Books.

Clocks and Watches, and Bells. By Sir Edmund Beckett, Bart. (late E. B. Denison). London: Lockwood and Co.

No telegraphist should be without this book. It is one of the best treatises in the English language on clockwork. Clockwork plays such an important part in most telegraphic apparatus that its construction and regulation should be as familiar in the mouth of the telegraphist as household words. Sir Edmund Beckett's little work has now reached its sixth edition, and it has been revised and considerably enlarged. We have here all that need be known about measures of time, both ancient and modern; of clocks and watches, pendulums and escapements, trains and dials, wheels and pinions, compensations and striking parts.

Strange to say, however, he does not explain how the practical unit of time—*the second*—is derived. The sidereal day, or the time between two successive passages of the same star over any given meridian, is the ultimate regulator of all clock time, and is therefore the practical standard of time. But the second, or the *unit* of time, is the $\frac{1}{24\times60\times60}$ part of the *mean solar day*, or the mean interval which elapses between successive passages of the sun across the meridian of any place,—which is the average length of all the solar days in the year.

The illustrations are excellent.

He devotes a few pages to the description of electrical clocks, and to the distribution of time by balls and guns, but he is evidently not an advocate for electricity in the working of clocks.

Electrical Science in English and Foreign Journals.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences.

No. 26. December 28, 1874.

The whole of this number is filled with the Academy's report, delivered by M. Faye, in which he sketched out the origin of the various prizes offered by the Society, and eulogises the scientific labours of the members. The speech is immediately followed by a list of the prizes awarded, for 1872 and 1873, for treatises in mathematics, mechanics, astronomy, physics, chemistry, &c.

We notice that the *Prix Gegner* for 1872, worth 4000 francs, was awarded to M. Gaugain to enable him to continue his researches in electricity and magnetism. The 1873 *Prix Poncelet*, a prize for mechanics, was unanimously given to Sir W. Thomson for his excellent labours relative to mathematical physics, and particularly for his work, *Reprint of Papers on Electricity and Magnetism.*

Amongst the subjects proposed for future years there appears one on the *Application of Electricity to Therapeutics.* It will be awarded as a medical and chirurgical prize.

Annales Telegraphique.

Vol. i., Third Series. July and August, 1874.

Electric Magnitudes, and their Measure in Absolute Units.—E. E. Blavier.—This paper is an explanation of electrical terms, and contains matter to be found in text-books of electricity.

Meyer's Autographic Apparatus, Mercadier's Electro-Diapason, and some other papers on subjects which have already been treated of in our pages during the course of last year.

September and October, 1874.

Continuation of M. Blavier's paper.

Poggendorff's Annalen der Physik und Chemie.

Vol. clii., No. 8, 1874.

Certain Experimental Investigations on Electric Vibrations.—N. Schiller.—The author's conclusions are—(*a*). The method of Helmholtz furnishes an accurate means for the experimental investigation of the theoretic laws of electric vibrations, and leads to various determinations of magnitudes in this department. (*b.*) The duration of the vibration of oscillating currents increases as the square root of the potential of the current and the total capacity of the conductor, and of the intercalated condenser. (*c.*) The conductive power of the oscillating layers of a conductor has a manifest influence upon the suppression of the electric vibrations therein. (*d.*) The determination of the duration of the vibrations of oscillating currents leads

to a comparison of the capacity of the condensers with each other, and of the potentials of the conductors. (*e.*) The same determinations give the possibility of measuring dielectric constants when the duration of the charge is very brief. From such measurements it appears that the dielectric constants become smaller, the smaller the duration of the charge. (*f.*) The determination of the suppression of oscillatory currents gives the possibility of measuring the conductivity of feeble conductors.

Measurements of Terrestrial Magnetism.—Karl Braun (conclusion).—This part of the memoir treats of the determination of intensity by means of the inclinatorium, and remarks on measurements with the magnetometer.

Magnetic Function of a Ball of Soft Iron.—Dr. Carl Fromme.—The permanent momentum of a rotatory ellipsoid of soft iron increases in the first place with the increase of the magnetic force, attains a maximum, and then declines. The magnitude of the maximum, its time of appearance, as well as the subsequent decrease of the momentum, are all inversely proportional to the constant C, which depends on the eccentricity, and becomes smaller as this increases. The ratio of the temporary momentum to the permanent decreases at first to a minimum, which coincides in point of time with the maximum of the permanent momentum, and then again increases. The magnitude of the ratio is inversely proportional to a function of the eccentricity of the ellipsoid of revolution.

Effects of Lightning on the Steeple of St. Martin's Church, Basle.—E. Hagenbach.—The following points deserve notice:—For the space of more than 3 metres two insulated wires had been laid, for protection, in a leaden pipe. For this entire extent the copper of the wires was perfectly unchanged, whilst the gutta-percha coating showed marks of fusion in several places. This may be explained by the assumption that the conductor surrounding the wires must have acted, as in the experiments of Faraday, Siemens, &c., so that for this space an equal amount of electricity was discharged in a feebler current, but of longer duration. The wire became red-hot without being destroyed, and found time to communicate its heat to the surrounding matter.

Reply to Herweg's Critique on the Essay "On the Nature of Electricity."—E. Edlund (See *Annalen*, Bd. 150, p. 623).—The remark of M. Herweg seems to have arisen from the circumstance that perhaps, in the Essay, the distinction between the speed of motion of the molecules of the ether and the speed of the propagation of this motion has not been rendered sufficiently clear. The intensity of a galvanic current depends on the first of these speeds, *i.e.*, the speed of motion, but not on the second or that of propagation. The author refers to his work—"Théorie des Phénomènes Electriques." (Stockolm: Nastedt and Söner).

Revista de Telegrafos. December, 1874.

The non-official portion of this number contains an article on the "General Postal Treaty," and on "International Telegraphic Arrangements," taken from the *Journal Telegraphique;* a letter from San Sebastian, describing the telegraphic service there; a notice of the *Annales Telegraphiques;* the conclusion of the paper on "Projections;" and a paper on Holland, having no connection with telegraphy or with any branch of physical science.

Repertorium für Experimental Physik. Band v., Heft. 1874.

Electro-Dynamic Elementary Law.—Theodor Wand.—This memoir occupies more than half the journal. The author sets out with the statement of the fact that an electric current, by augmenting its intensity, induces a current in the opposite direction in an adjacent conductor. This experimental proposition may be also thus expressed:—Electricity reacts upon its change of locality with an electro-motive force proportional to the second differential coefficient of the locality, taken in point of time. Our hypothesis extends this proposition, so that electricity reacts not only upon its change of place as the second differential coefficient of the place, but also upon its condensation as the second differential coefficient of the density. In successive sections the author gives general explanations, the law of Ampère, the principal of the conservation of force and Ampère's law, with the action between two elementary currents according to the same law; the "integral law" of F. Neumann; Weber's law; the electric current on the hypothesis of two electric fluids; general demonstration of the unstable equilibrium following from Weber's law, with the aid of the proposition that every motion may be decomposed into a rotatory (whirlpool-like) and a radiant; Weber's law gives no determined force for radiant motion; further objection to Weber's law; the electric forces for currents without points of condensation developed according to Weber's law; the differential equations deduced from Weber's law not incorrect, but incomplete; their completion; C. Neumann's new theory; definite form of the elementary law; magnetic action of any electric process soever; fresh confirmation of the author's hypothesis; constant *c* (§ 14) may be assumed = unity; potential function of a current and of a sphere-solenoid; determination of constants.

Simple Galvanoplastic Apparatus for Students.—Dr. F. Plettner.—The description of a very simple and cheap apparatus for the galvanoplastic process.

GRAMME'S MAGNETO-ELECTRIC COMPANY.—In the first and second volumes of this Journal will be found records of results of experiments on Gramme's Magneto-Electric Machine, by Mr. Robert Sabine, C.E., M. Gramme, M. Gaugain, the Count du Moncel, &c. Reference is also made to an exhaustive article by Mr. William Crookes, F.R.S., which appeared in the *Quarterly Journal of Science* for July, 1873. A Company is now being formed for the application of the machine to the various industrial purposes proposed by the above-named gentlemen. The capital of the Company is to be £250,000, in 25,000 Shares of £10 each. The first issue is 17,500 Shares, of which 14,000 are now offered for Subscription, the balance—3500 Shares—being taken by the Vendor. The Share Lists close for London on the 4th, and for the Country on the 5th instant.

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